Report NO. TR-[illegible]

U. S. Army Prosthetics Research Laboratory
Walter Reed Army Medical Center
Washington 12, D. C.

POROUS EPOXY LAMINATE EVALUATION

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Chief, Plastics Dev. Branch

Approved by: [signature]
For Director

Part VII, Effect of Curing Time on Laminate Properties

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Sample	Cu Tes
A	70
B*	70
C	70
D*	70
E	80
F	80
G	80
H*	80
I	100
J	100
K	100
L	100

*Sample B, D and H were disc

[illegible]

The [illegible] are plotted in Fig. 1 and listed in Table II. It may [illegible] the highest effective porosities were obtained at 70°C. The [illegible] also obtained at 100°C. The physical properties of the laminates [illegible] in table II.

[illegible]

[illegible] samples A and G (70° cure) were the only two laminates in this [illegible] it is difficult to reach any definite conclusions concerning the effect [illegible] time on their properties. However, there is an indication that a [illegible] compressive strength may be obtained by curing between 1 and 3 hours, [illegible] at or 2 hours. The 70°C series will be completed in the future.

[illegible] is F (180 minute cure) in the 80°C series shows the best compressive [illegible]. It is interesting to note that this sample also was cured for 2 [illegible] all of our 'standard' laminates have been cured under conditions [illegible] to sample F's. Of all the samples tested, this one had the highest [illegible] characteristics. However, in the 100° series, the 1 hour sample [illegible] more favorable compressive properties. This is probably due to the [illegible] curing temperature; the 2 hours being too long at such a high temperature.

[illegible]

Again in the 70° series, due to incomplete results, no definite conclusion [illegible] be derived. However, generally it can be stated that the best results should [illegible] between 1½ and 2 hours.

In the 80° series the 1 hour cure appears to have more favorable physical [illegible], but since the effective porosity is only half that of the 2 hour cure, [illegible] hour cure again may be considered the most desirable. In the 100°C series [illegible] hour cure proved to give the best result.

[illegible]

[illegible] A (70° x 60 minutes) and I (100° x 30 minutes) gave similar impact [illegible] although they are at the extremes of porosities, sample A having a [illegible] (80%) versus sample I with 13%. Both of these samples showed [illegible] failure. Previous experiments have shown that the laminates [illegible] that give higher impact resistances. This trend was [illegible].

At high porosities, the laminate is so resilient that it collapses under a relatively light load. On the other hand, a laminate will become more susceptible to an earlier craze or crack when the effective porosity is low.

IV. CONCLUSIONS

1. The compressive stress at buckle of the laminate is not significantly affected by curing temperature or curing times over the range tested. Therefore, the effective porosity should be the controlling factor to be considered when choosing curing conditions with respect to compressive properties.

2. The bearing stress at 4% elongation, like compressive stress, does not appear to be significantly affected by curing conditions over the range tested. Again, the effective porosity appears to be the controlling factor.

3. The impact resistance like bearing and compressive strength is controlled by effective porosity rather than curing conditions over the range tested. As a result of these tests we make a general conclusion that the laminates may be completely cured at a temperature of 70°C or higher after a minimum precure of 60 minutes. The best conditions for curing, taking into effect effect porosity and physical properties, appear to be 70°C for 120 minutes. Longer or higher temperatures tend to cause discoloration of the laminates.

V. RECOMMENDATIONS

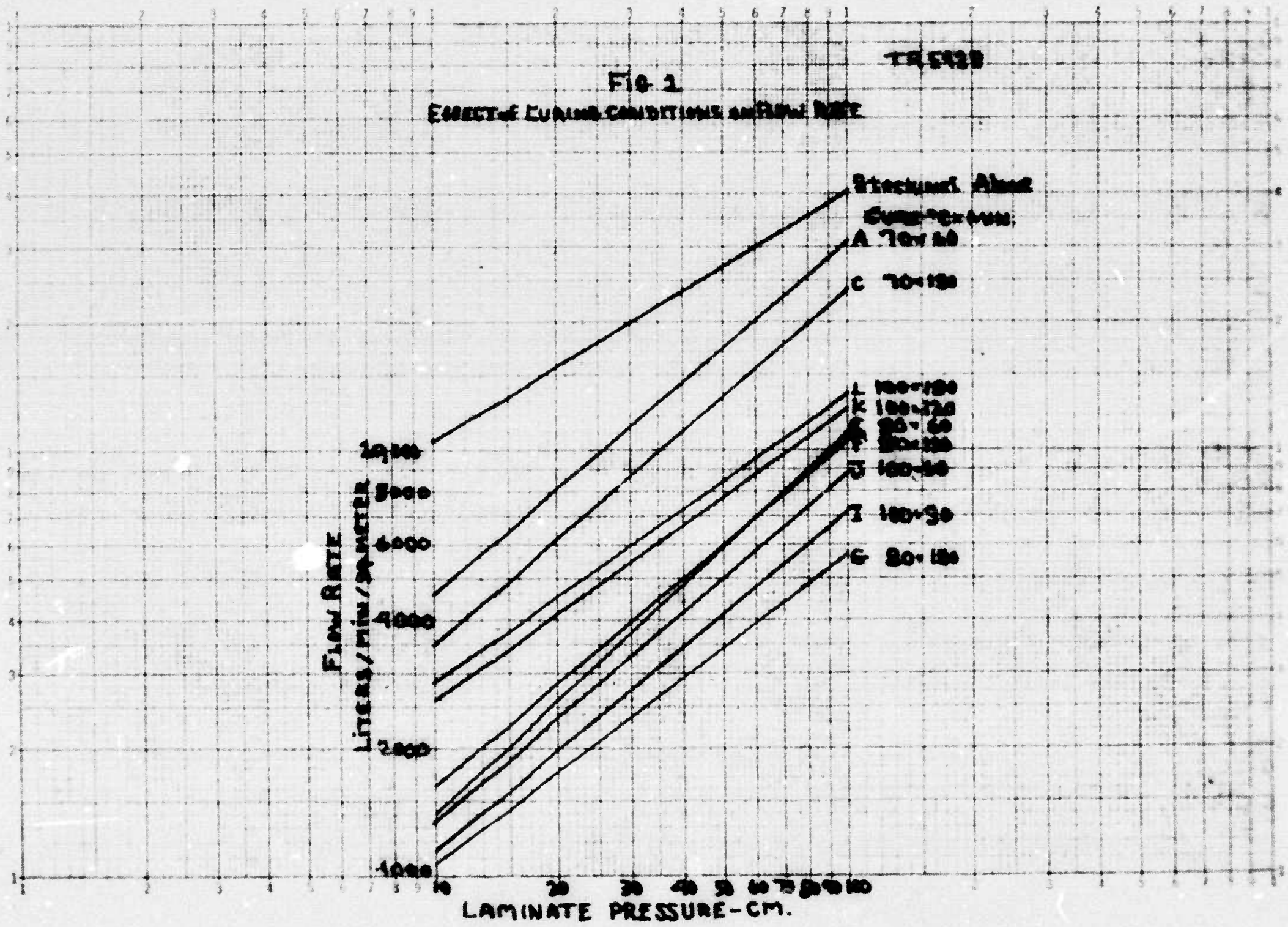
1. An addenda to the Link Shop procedure (T.R. #5040) for fabrication of porous laminated arms should be prepared. This addenda should contain a recommendation stating the use of a 70°C cure instead of the 80°C cure now in use.

TABLE II

Mix	Cure Temp (°C)	Cure Time (min.)	COMPRESSION Stress at Buckle (psi)	Strain (in/in)	BENDING Strain Stress (psi)	Ult. Stress (psi)	IMPACT Initial Crack (in. lbs)	Collapse (in. lbs)	Effective Porosity (%)
A	70	60	554	.0109	1011	10,366	12	15	60.4
C	70	180	804	.013	1133	4,565	18	21	46.2
E	80	60	513	.006	1656	6,083	15	18	20.3
F	80	120	1407	.015	2153	8,230	15	21	21.2
G	80	180	1262	.013	3300	10,000	15	18	12.4
I	100	30	753	.009	2519	7,244	12	15	12.3
J	100	60	663	.004	2461	8,076	18	21	17.7
K	100	120	519	.023	2366	8,630	15	21	28.4
L	100	180	737	.0109	1111	5,185	15	18	30.4

Fig. 1

EFFECT of CURING CONDITIONS and FILM[illegible] RATE



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